

REMARKS

This is a full and timely response to the final Office Action dated June 9, 2003 (Paper No. 23). This After Final Response requests reconsideration of certain findings of fact in connection with the rejection of claims 1 and 4-6 under 35 U.S.C. § 103(a) and otherwise responds to the Response to Arguments. Reexamination and reconsideration under 37 C.F.R. § 1.116 are therefore courteously solicited.

Entry of this After Final Response and allowance of this application is solicited and warranted in that this submission demonstrates that the continued rejection of the pending claims is factually and legally in error. No new issues requiring further search are presented. Thus, at the very least, this paper places this application in better condition for appeal by clarifying the Applicant's counterarguments to the well-expressed but unpersuasive positions of the Examiner.

Claim Rejections- 35 U.S.C. § 103(a):

In the action, claim 1 was rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,146,542 ("Ha") in view of either U.S. Patent No. 5,024,722 ("Cathey") or U.S. Patent No. 5,846,886 ("Hattori"). These rejections are respectfully traversed.

The present invention is directed to the use of a very particular combination of gases for the purpose of dry etching a metal having specific properties such as those of tungsten, and for making a semiconductor apparatus using the same combination of gases. The background section of the present application teaches that the combination of gases is important, as none of the gases alone is sufficient to accomplish the purposes of the

inventive methods. There is no doubt that the individual gases used in the etching combination are not new themselves. There is also no doubt that some of these gases are well known to be used in combination for the purpose of etching tungsten. However, as will be established below, the exact combination of gases in the methods of the present invention is new, and there is no teaching or suggestion in the prior art of record for combining the known gases in the manner disclosed and claimed.

The Examiner has conceded in section 2 of the Action that Ha fails to teach of a method for dry etching tungsten using a mixed gas containing a fluorocarbon. Consequently, in order for the present invention to be rendered obvious, there must be some teaching somewhere in the prior art that Ha's etching gas combination should be modified to replace SF_6 and/or NF_3 with a carbon-containing fluoride gas.

Cathey and Hattori clearly fail to suggest such a replacement. While the Examiner continues to assert that it would have been obvious to use CF_4 in Ha instead of NF_3 or SF_6 because Cathey or Hattori teach the equivalence among these etchants for etching tungsten, the present invention teaches that this is not so. As disclosed at page 4 of the specification, when high-order fluorine gases such as sulphur hexafluoride (SF_6) are employed for dry-etching tungsten, the quantity of radicals increase dramatically. This increase in radicals results in a non-uniform etching of the tungsten layer, otherwise known as microloading. These adverse affects, however, are successfully avoided when a low-order carbon-containing fluorine gas like CF_4 is used in place of other high-order fluorine gases in a mixed gas to etch a tungsten layer. (See page 7 of the specification).

In other words, there are distinct advantages attained when low-order fluorocarbons like CF_4 , instead of NF_3 and SF_6 , are used in conjunction with the presently disclosed combination of gases for dry-etching tungsten. Accordingly, these distinct advantages show that the use of low-order fluorocarbons like CF_4 in the presently disclosed mixed gas for dry-etching tungsten is not equivalent to the use of either SF_6 or NF_3 . Cathey and Hattori clearly fail to appreciate this advantageous application of fluorocarbons. The discovery and application of this unique advantage represents a portion of the novelty of the present invention sought to be patented by the Applicants.

Moreover, it is again emphasized that the present invention is not directed to a single etching gas, but a very particular combination of gases. The replacement of one gas for another in a particular combination of gases, like the Ha combination, must be done with some motivation, and the broad assertion that one gas is a known tungsten etchant is not sufficient motivation to replace one gas for another gas in a specific combination of gases, especially when there is no teaching or suggestion that the particular combination is in any way deficient or in need of improvement. Neither Cathey nor Hattori teach or suggest that CF_4 performs suitably as an etching procedure when combined with nitrogen. Nitrogen is completely absent from the teachings of Cathey and Hattori. Thus, a person of ordinary skill in the art would recognize that Cathey and Hattori have not considered the use of CF_4 in an etching gas combination that includes all of the gases listed in claims 1 and 4 of the present application. Thus, such a person would not be motivated from reviewing the references as a whole to replace CF_4 from Cathey or Hattori with SF_6 or NF_3 . This is particularly true in light of Ha's inherent teaching away from making such a

replacement, as discussed in Applicant's response filed May 14, 2003, incorporated herein by reference as if fully repeated.

Therefore, because Ha admittedly fails to teach a method for dry etching tungsten using a mixed gas containing a fluorocarbon, and because the use of CF_4 when etching tungsten is not equivalent to the use of NF_3 or SF_6 , and further because Ha teaches away from making any such replacement, one skilled in the art would lack the requisite motivation to combine the teachings of Cathey or Hattori with those of Ha, and a *prima facie* rejection of claim 1 has not been established. It would appear that any suggestion of such replacement or substitution flows, not from the prior art going forward toward the invention claimed, but in a hindsight manner based on the teachings of the specification. For the claimed combination, there is no motivating teachings found to support factually the proposed substitution in light of the foregoing arguments. Withdrawal of this rejection is therefore respectfully requested.

Additionally, claims 4 to 6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ha in view of either Cathey or Hattori, and further in view of U.S. Patent No. 6,296,780 B1 ("Yan"). Because claim 4 recites essentially the same chemical limitations as those recited in claim 1, the arguments discussed above regarding claim 1 apply with equal force to claim 4.

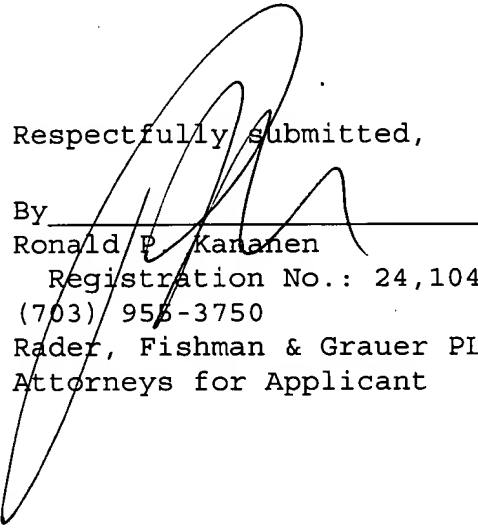
Moreover, the Yan reference fails to compensate for the deficiencies of the prior art discussed above. Yan mentions that carbon-containing fluoride gas may be used to process a substrate including an OARC layer and a TiN ARC layer, but makes no mention of using the claimed combination of gases for etching tungsten. Therefore, one skilled in the art would lack the requisite motivation to combine the teachings of Ha, Cathey, Hattori, and Yan.

Conclusion:

For at least the reasons explained above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

Dated: July 10, 2003

Respectfully submitted,

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